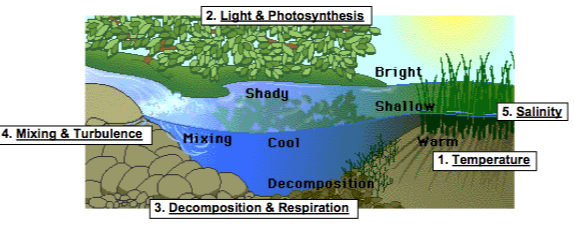
**Dissolved Oxygen and Primary Productivity Activity**

**Introduction**: DO is often used as an indicator of water quality. You have probably read or seen news reports of fish kills that have been linked to sewage spillage. Aquatic microorganisms metabolize the sewage, using up DO. As DO levels drop, fish cannot acquire the oxygen they need, and they die. DO concentration is expressed in parts per million (ppm) or mg/L. Desirable fish species such as trout and perch require a minimum of 8 mg/L dissolved oxygen to survive. Less-desirable fish such as carp can survive at dissolved oxygen levels as low as 2 mg/L. Below 2 mg/L, only invertebrates such as sludge worms and mosquito larvae can survive. How does oxygen enter the water?

**Purpose**: In this activity, you will analyze the factors that can affect DO availability and productivity in a lake when depth is the variable.

**A. Research Background**: How do the following factors affect the availability of oxygen in a pond or lake?

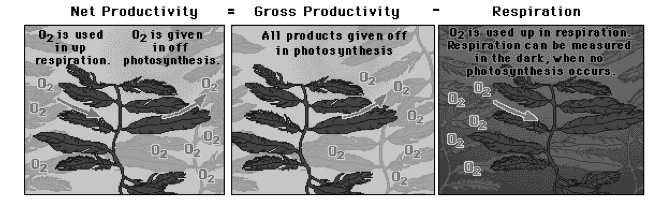
1. Temperature\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Light\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Decomposition\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Mixing/Turbulence\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Salinity\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **Productivity**: What do the following terms mean…IN YOUR OWN WORDS!

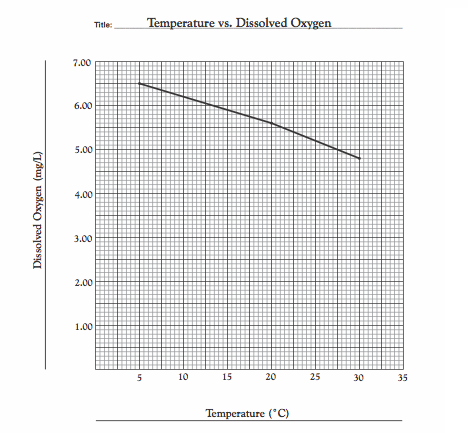
1. Primary Productivity
2. Gross Productivity
3. Net Productivity

2. Why do we use DO as a measure of productivity?

3. Using the diagrams below explain:



1. How does putting a sample of pond water and algae/freshwater plants in the light enable us to measure gross productivity?
2. How does putting a sample of pond water and algae/freshwater plants in the dark enable us to measure respiration?
3. How does subtracting the two enable us to indirectly measure net productivity?

**B. Lab Analysis: Effect of Temperature on Dissolved Oxygen**

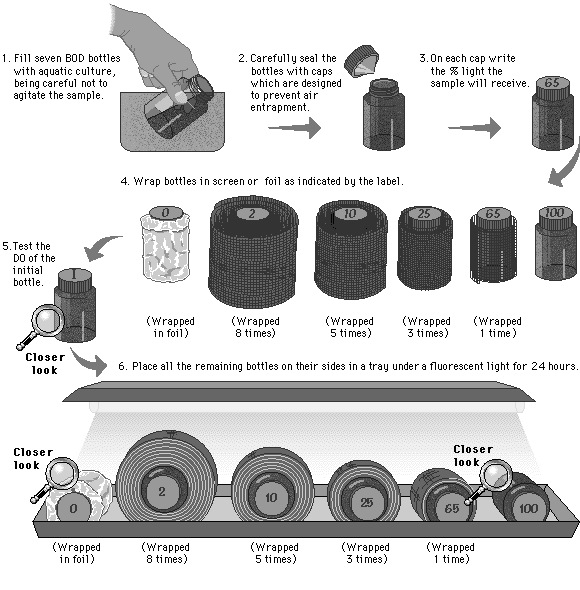
Look at the graph:

1. Explain the relationship of temperature and dissolved oxygen.
2. Explain why a fish tank placed should not be placed next to a radiator?

**C. Lab Analysis: Model of Productivity as a Function of Depth in a Lake**

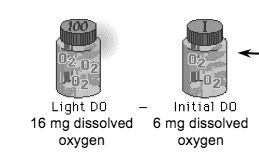
We are going to look at the biological factors that affect dissolved oxygen in a body of water. We are taking a sample of pond water (with algae) and then model different depths in the pond by using screening to block out successive amounts of light. One hundred percent light for shallow depth, all the way to 0% light for deep ponds.

1. Make a **hypothesis** regarding the amount of net productivity for pond water when light intensity is the variable:

****Here is the lab set up:

1. What does wrapping the bottles in mesh/screen do for the experiment?
2. Why is step 5 done?

**D. Analysis of Results: Productivity in a Pond**

1. If the initial DO is 6mg of DO and the amount of DO found in the 0% bottle was 1mg, determine the amount of DO used for cell respiration.
2. Determine the NPP of the 100% bottle:

So, any of the bottles can have the NPP determined by subtracting the initial DO bottle from it. Why then would one need the respiration measurement from the dark bottle? To find the **Gross Productivity** of the algae.

1. Determine the Gross Productivity for the 100% bottle:

*(NPP = gross productivity – cell respiration)*

The table below is data from another experiment. Fill in the data for the NPP and GP for each bottle. Remember how you calculated the NPP and GP.

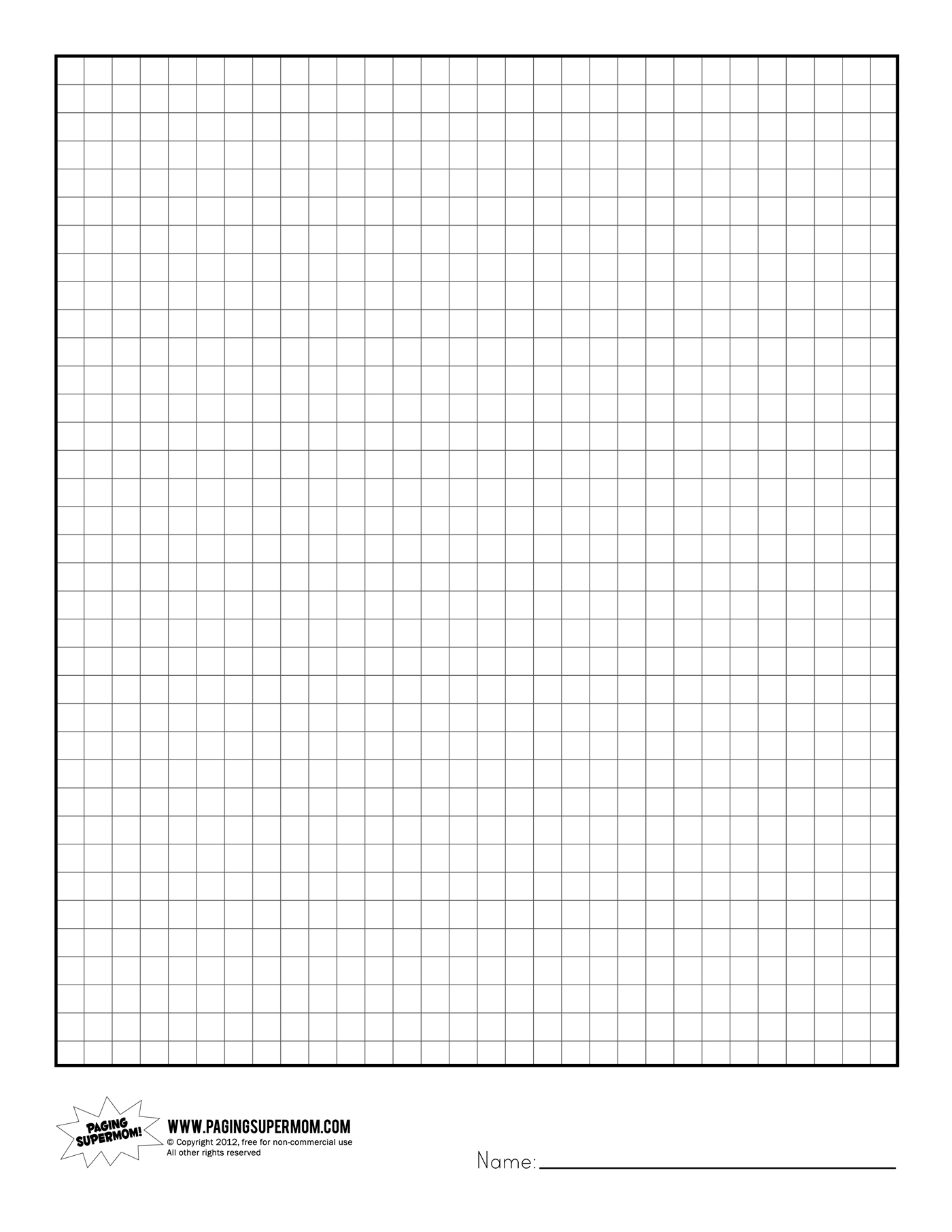
Group Productivity Data

|  |  |  |  |
| --- | --- | --- | --- |
| Bottle | DO mg/l | NPP | GP |
| Initial | 7.40 |  |  |
| Dark (0%) | 4.90 |  |  |
| Light 100% | 10.90 |  |  |
| 65% | 10.60 |  |  |
| 25% | 8.95 |  |  |
| 10% | 7.80 |  |  |
| 2% | 5.10 |  |  |

1. What is the DO used for cell respiration?

**Graph** the data for the Gross Productivity and Net Primary Productivity. Title and label appropriately.

1. The IDV in the experiment is: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. The DV in the experiment is:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



1. At approximately what light intensity does the rate of respiration equal the rate of photosynthesis?

**E. Conclusion Questions**:

1. Would you expect the dissolved oxygen levels in water sampled from a stream entering a lake to be higher or lower than the dissolved oxygen levels in water sampled from the lake itself? Explain.
2. Would you expect the dissolved oxygen levels in water sampled from a lake at 7AM to be higher or lower than the dissolved oxygen levels in water sampled at 5PM? Explain.

One of the major sources of water pollution is the runoff from fertilizer used in agriculture and on suburban lawns as well as golf courses. In particular, the nitrogen and phosphorus nutrients in fertilizer create problems in the streams and ponds it flows into.

1. Why do nitrogen and phosphorous promote a lot of plant/algal growth?
2. What problems do algal blooms cause in ponds and lakes? Why isn’t a lot more producers a good thing?